
NASA's Productivity Improvement and Quality Enhancement Initiatives

**September 1982
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National Aeronautics and
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Foreword

The National Aeronautics and Space Administration celebrated its 25th Anniversary in 1983 at the Air and Space Museum in Washington, DC, with President Reagan in attendance. We look back on the accomplishments of these twenty-five years with pride in our missions and our people.

NASA captured the world's imagination during the days of the Apollo mission. So much so, that we now talk about the Apollo era. In the 1970s, we moved into the Space Transportation business, and in the 1990s, we look forward to having a manned Space Station. Each succeeding mission has presented its own challenge in terms of technology and resources. This is especially true today, when we are being asked to do more with less.

To ensure that NASA continues to be a productive and quality conscious agency, one of our highest Agency goals is leadership in the development and application of practices which contribute to high productivity and quality. Technology represents America's greatest competitive strength, and this country has a solid scientific and engineering foundation. Traditionally, we have spent more money on research and development than Japan and Europe combined, and we are the source of most of this century's significant innovations. We should build on this solid base and use it more effectively.

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From the beginning of the U.S. Space Program, government, industry, and the academic community have worked together in a unique partnership to establish a tradition of technical excellence. We must continue in that tradition and increase our productivity growth, so that our standard of living remains high through technological and industrial competitiveness.

September 1984

James M. Beggs
Administrator
National Aeronautics and
Space Administration

Preface

A key factor in higher productivity growth rates is quality. Poor quality costs money in repairs and replacement, and is known to adversely affect morale. Our goal is to communicate to all of our people, our contractors, and the taxpayer that quality and productivity are of the utmost importance to us. We are doing this by making productivity improvement and continued quality enhancement the Agency's eighth principal goal:

"Establish NASA as a leader in the development and application of advanced technology and management practices which contribute to significant increases in both agency and national productivity."

In our review of successful organizations, we found that higher productivity growth rates may be achieved if senior management ensures that the following three characteristics prevail in an organization:

- (1) An innovative environment where quality improvement is institutionalized and decisions are based on quality improvement and customer satisfaction, as opposed to decisions based solely on profits, costs, and production goals.
- (2) An understanding that institutionalization of productivity and quality goals are a long-term process, and that

management incentives and organizational reviews need to have a long-term orientation. Gauges that are solely short term may prove to be detrimental.

- (3) A philosophy that encourages employees to contribute to organization success. Employee involvement programs, such as employee profit sharing, employee suggestions, and quality circles, are notable examples.

The following initiatives were selected for publication because they convey the broad scope of the NASA-wide effort; they do not constitute all of the initiatives underway at Headquarters and Centers. Many of the initiatives are long term in scope and will require a sustained commitment if they are to become fully integrated into the Agency's missions.

September 1984

David R. Braunstein
Director, Productivity Programs
National Aeronautics and
Space Administration

HEIGHTEN

NASA's productivity and quality objectives were formulated under seven goals, having the acronym HEIGHTEN.

- I HEIGHTENING management and employee knowledge and awareness
- II ENCOURAGING greater employee participation in management decision making
- III IDENTIFYING impediments as well as opportunities for greater productivity
- IV GETTING HIGHER contractor/NASA team involvement through better productivity contracting approaches
- V TRYING out new management practices and using new technology
- VI EVOLVING productivity trend analysis techniques
- VII NOTING, rewarding, and diffusing successful approaches throughout the organization

PRODUCTIVITY AND QUALITY IN HEIGHTEN

I. Heightening Management and Employee Knowledge and Awareness

To successfully launch productivity awareness throughout an organization, at least three elements must be in place: (1) top management support, (2) decentralization of decision-making, and (3) on-going management development.

Top Management Support

In December 1982, the Productivity Improvement and Quality Enhancement (PIQE) Steering Committee was formed to provide policy guidance and oversee Agency-wide productivity initiatives. The Committee is composed of all of NASA's senior managers and is chaired by James Beggs, the Administrator. It has three major goals:

- o Establish NASA as a leader in the development and application of advanced technology and management practices which contribute to significant increases in both agency and national productivity.
- o Identify areas in which NASA can introduce innovative management practices and initiate actions to effect improvement.

- o Provide additional incentives for NASA contractors to identify and implement productivity and quality improvement efforts in their projects.

Since January 1983, Mr. Beggs and all the members on the Committee have actively demonstrated their interest in productivity awareness by making periodic two-day visits to companies that have made significant contributions to productivity enhancement. They made the first of these visits on January 5-6, 1983, to the Westinghouse Productivity and Quality Center, a division of the Westinghouse Electric Corporation in Pittsburgh, Pennsylvania. Westinghouse executives provided insight into organizational resistance to productivity enhancement as a top management goal, and noted that the biggest hurdle to overcome is the Nine-Foot Tall Syndrome, that is, "Who needs a productivity effort when we are already doing a great job?" It was stressed that solutions to productivity problems are in management's hands and the challenge is to identify the obstacles to be overcome and devise strategies for solutions. Moreover, the Committee was reminded that productivity improvement is a long-term process; it should start slowly and grow gradually.

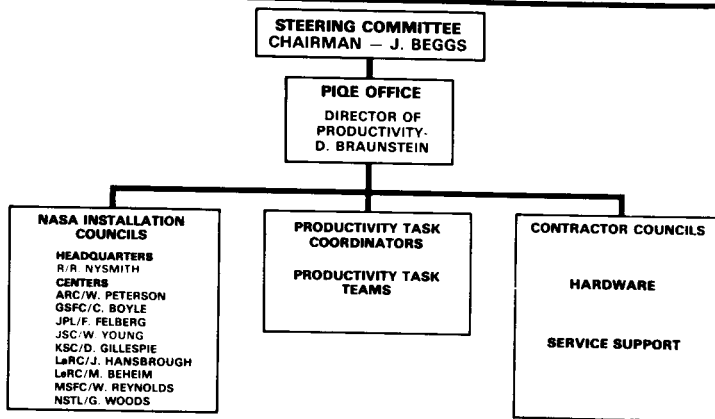
The second meeting was on July 13-14, 1983, with senior executives at TRW, Inc. (Space and Technology Group), Redondo Beach, California. TRW's extensive productivity programs were reviewed, and the Committee received a proposal for including productivity objectives in the on-going Gamma Ray Observatory (GRO) Program.

The third meeting was on January 12-13, 1984, at the corporate headquarters of Hewlett-Packard Company in Palo Alto, California. Members of Hewlett-Packard's senior management team explained the famous "H-P" culture, characterized by open communication, trust, and belief in the responsibility of the individual, and its positive relationship to productivity enhancement. These visits do not constitute the total input received from private industry, but it is significant that NASA's entire senior management team made a commitment to discuss productivity and quality issues with private industry counterparts despite busy schedules. The visits demonstrate that NASA's senior management team fully supports the Agency's eighth goal.

Decentralization of Decision-Making

NASA Headquarters and all field installations have formed special task groups and assigned key individuals to select and implement productivity initiatives that fall under the rubric of the seven HEIGHTEN goals stated earlier. Because each NASA installation has a different organizational culture, it was appropriate for each installation to choose its own initiatives to complement a particular Program and/or reflect a Center Director's priority. The task of coordinating and communicating all of these efforts is carried out by the Productivity Improvement and Quality Enhancement (PIQE) Office at Headquarters which receives its guidance from the Steering Committee.

NASA PIQE PROGRAM ACTION NETWORK



NASA HQ NAB3 2583(1)
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On-going Management Development

NASA has an extensive in-house Management Development Program for its mid-level managers and senior executives, and professional development is encouraged throughout the Agency. However, to emphasize management practices used by highly productive organizations, notably participative management practices, a special two-day seminar, "Managing Toward Goals," is being introduced to NASA installations during 1984 and 1985. The seminar will provide a forum for managers to discuss impediments toward realizing specific productivity goals.

II. Encouraging Greater Employee Participation in Management Decision-Making

Successful organizations understand that employee contributions and communications in large organizations are enhanced through increased employee involvement. Employee involvement in management decision-making can be encouraged through Quality Circles, Employee Suggestion Programs, and the Nominal Group Technique.

NASA Employee Teams (NETs) (Quality Circles)

During 1982-1983, NASA installations were encouraged to adopt one-year NASA Employee Team pilot programs, so that management, unions, and other employees could become familiar with the process. Langley Research Center and Lewis Research Center had initiated Quality Circles earlier. Both completed the pilot phase and are

expanding their teams. NET pilot programs are currently operating at the Ames Research Center, Goddard Space Flight Center, Jet Propulsion Laboratory, Marshall Space Flight Center, Kennedy Space Center, Johnson Space Center, NASA Headquarters, and National Space Technology Laboratories. There are over eighty NASA Employee Teams operating throughout the Agency, and it is anticipated that this voluntary team approach to problem solving will continue to appeal to a broad section of the NASA population.

The decision to adopt this aspect of participative management to NASA's R&D environment, with its proportionately large white collar workforce, was made on a Center-by-Center basis after a review of successful quality circle programs in the private sector. Although quality circles are primarily associated with the manufacturing sector, they are successful in white collar industries and are intrinsically related to NASA's way of doing business.

A key objective in establishing employee teams in large organizations is to reap the benefits from small group problem solving. All of the successful companies in the best seller In Search of Excellence by Peters and Waterman cited the belief that small groups form the basic organizational building blocks. Moreover, individual team members learn how to work effectively in groups, improve analytical and communication skills, and gain confidence through effective decision making.

Employee Suggestion Program

On June 1, 1984, the Agency began a promotional campaign to revitalize its Employee Suggestion program. This program is part of the government's Incentive Award Program, and was established by Congress thirty years ago.

In the 1960s, NASA benefited from implementing a high rate of employee suggestions, but by 1982 the suggestion rate had dropped dramatically. In October 1983, an Agency-wide meeting was held at Goddard Space Flight Center to review successful programs within government and private organizations, and to determine the characteristics necessary for a revitalized NASA program. Important areas identified were top-level management support, adequate resources to run a program, responding to suggestions in a reasonable timeframe, and soliciting ideas from contractors for savings. A renewed emphasis on recognition and publicity is now increasing employee suggestions for improving NASA operations.

Nominal Group Technique

The Nominal Group Technique was developed by two social scientists in 1968. Since then, it has been used by organizations in the private and public sectors. It is especially useful for managers seeking to reach group consensus on controversial decisions. It is a structured group process whereby the group responds

to a specific goal statement through a sequence of activities.

The specific steps are:

1. Silent generation of ideas in writing in response to the goal statement.
2. Round robin feedback from group members and recording of each idea on a flip chart.
3. Discussion of each recorded idea for clarification and evaluation.
4. Individual voting on priority ideas with the group decision being mathematically derived through rank ordering or rating.
5. Identification of top ideas and closing discussion.

The structured group process ensures equal participation by all group members in an atmosphere that is free of conflict. Thus, group members may focus all of their attention on the specific goal statement.

The Nominal Group Technique was used successfully at NASA/Contractor workshops in 1983 to identify and reach consensus on important impediments to productivity. The process is currently being used in a pilot program to establish productivity trend analyses.

III Identifying Impediments As Well As Opportunities for Greater Productivity

Concurrent with initiating a productivity improvement effort, impediments to organizational effectiveness should be identified. At NASA, an agency-wide survey was conducted to identify and categorize organizational impediments to program planning and execution.

Survey Findings

The survey identified a large number of specific impediments, although only some were agency-wide issues. Management issues included high turnover of top management, conflict over roles and responsibilities, issues of delegation of authority, the need for improved strategic planning, and investment for new plant and equipment. Many impediments referred to constraints resulting from the Federal budget process, personnel system, and the procurement process. Agency-wide efforts to reduce and/or remove categorized impediments continue. Examples of specific impediments are given below.

Federal Budget Planning and Execution The one-year budget cycle inhibits the long-range planning that is intrinsic to R&D programs. Consequently, much time is spent on re-planning, and advanced programs suffer. In this regard, the White House Science Council's Federal Laboratory Review

Panel, the "Packard Study," recently recommended multi-year funding for R&D programs.

Management issues also included employee motivation, time management problems, and paperwork requirements. Progress to date includes expansion of employee teams to increase organizational effectiveness and a 20 percent reduction in agencywide paperwork and reporting. With respect to delays in procurement lead time, a special NASA task force was formed to study this problem. Their recommendations included additional delegations of authority, which are now being implemented.

Bonus and Merit Pay System Inequities The SES bonus system and the merit pay system contain perceived inequities, resulting in low morale. Congress has modified the SES bonus system (FY 84), and revisions to the merit pay system are anticipated.

Modernization There was an expressed need to automate many operations, utilize state-of-the-art laboratory equipment, and take advantage of new technologies. Office automation and upgrading of administrative ADP systems are a priority, and improved management information systems are being utilized.

The Educational Impediment - Barrier to National Productivity

Just over half of NASA's approximately 22,000 employees are scientists and engineers, and the Agency is concerned about future recruitment and retention of talented people from the scientific disciplines. This problem is exacerbated by the fact that our nation's once unchallenged preeminence in commerce, industry, science, technological innovation, and education is being eroded. What was unimaginable a generation ago has begun to occur. Other advanced industrial nations are matching and surpassing our educational attainments. For example, Japan graduates over twice the number of engineers as the United States and it has half our population. Our education system must graduate a better qualified student into our society, its industry, and the teaching profession, particularly in the mathematics and science disciplines.

The White House has shown a particular interest in this problem, understanding its relationship to low national productivity growth rates. NASA has responded energetically to President Reagan's "Partnership in Education" program by expanding its existing educational outreach programs to include:

- o National Shuttle Student Involvement Program (SSIP) for grades 9 through 12, a joint venture of NASA and the National Science Teachers Association to stimulate the study of science and engineering.

- o NASA Educational Workshops for Mathematics and Science Teachers (NEWMAST) for 200 precollege mathematics and science teachers.
- o Space Exposed Experiment Developed for Students (SEEDS) project to involve approximately 4 million students in 250,000 classrooms in space research.
- o Operation Liftoff, an educational outreach program aimed at stimulating interest in the study of math and science at 75,000 elementary schools throughout the country.
- o Teacher Resource Rooms at NASA field installations.

Through its educational outreach programs, NASA expects to make a significant contribution to productivity improvement at the national level.

IV Getting Higher Contractor/NASA Team Involvement Through Better Productivity Contractor Approaches

Approximately 85 percent of NASA's annual budget is placed with contractors. Therefore, any overall Agency productivity effort must include the NASA hardware and service/support contractors.

NASA/Contractor Productivity Council

A series of workshops was held during 1983 in which the contractors and NASA managers identified impediments to productivity in the NASA/contractor relationship. Each of the twenty contractors invited was given an opportunity to present views of approaches to improving quality and productivity. Upon completion of the presentations, the Nominal Group Technique was employed to identify the major issues. Two workshops, on April 26, 1983, and May 3, 1983, were held with hardware contractors, and a workshop with service/support contractors was held on June 21, 1983. These workshops identified the following major areas for improvements.

o Communication Between NASA and Contractors

It was suggested that improved communications would minimize the adversary role of "the customer" and result in a NASA/contractor team role. Moreover, increased delegation and the development of mutual trust would

result in smoother implementation of projects. One way this is being accomplished is through joint NASA/contractor employee teams.

- o Timeliness of Contractual Actions

From a contractor's point of view, untimely contract changes, waivers, and "approvals" undermine financial, technical, and schedule baselines.

- o Incentives/Rewards/Recognition

Contractors would like to see incentives/rewards for creative management, productivity improvement, and quality enhancement.

- o Standardization

It was recommended that NASA standardize specifications and standards among centers and projects, make greater use of military standards, and implement a DOD-NASA standardization effort. Also, the use of industry specifications would be helpful to contractors.

- o Building Quality Into Manufacturing Process

The contractors would like to have resources available for quality and manufacturing development during the

design phase to facilitate actual manufacturing processes, such as tooling, process controls, etc.

In addition, service/support contractors identified impediments/opportunities.

- o Incentives for Productivity

There was broad agreement on the need for contract incentives for productivity. The contract award fee could be structured to evoke quality performance and cost benefits to NASA and contractors. Also, contractors should receive bonuses for cost savings.

- o Service Contract Act

The contractors stated that the present Service Contract Act (SCA) is cumbersome and that high-technology contracts should be exempt. The contractors expressed a deep concern that computer programmers are being considered under the Act instead of as professional employees. The contractors recommended effective and realistic implementation of wage determinations and other selected aspects of the SCA.

- o Job Descriptions

Contractor personnel are sometimes overqualified and underutilized because NASA specifies a wide range of skills but may utilize only certain skills. Contractors recommended that careful attention be given to writing job descriptions so as to enhance cost effectiveness.

- o Award Equity

The contractors recommended that NASA have an award/recognition program for all support/service contractor employees, not only those in high-visibility positions. They recommended that NASA have more frequent reviews, with quantified measurement of the expected results. Consequently, contractor management will attempt to adjust operations to meet NASA requirements in a way that will be mutually beneficial.

As a result of these workshops, the NASA/Contractor Productivity Council was formed. It is made up of five groups which were asked to develop recommendations to address the impediments.

The groups presented their findings at a conference held at the Marshall Space Flight Center on April 26-27, 1984. More than 200 representatives from industry attended, along with the NASA Administrator and other

senior NASA managers. NASA's Chief Engineer will present an Agency-wide plan of action in the fall of 1984, and NASA installations will implement appropriate aspects.

Gamma Ray Observatory (GRO) Program

This is a six-year Program to launch an unmanned scientific satellite from the Space Shuttle for a two and a half year orbit. NASA and TRW have agreed to use the GRO Program as an experimental model for new productive ways of doing business. Based on this agreement, the Goddard Space Flight Center (GSFC) and TRW's Space and Technology Group have implemented the following productivity initiatives:

- o Management strategies that increase team work and communications (e.g., quality circles, employee suggestion programs, newsletter, etc.) are being implemented to maximize opportunities for contributions from employees.
- o Video Conferencing and Computerized Network System
GSFC and TRW have installed full motion video conferencing rooms at their facilities to save travel expenditures. To improve communication between GSFC subcontractors and TRW, a common data base has been established and is maintained by a computerized network system.
- o "Red Flag" Cost and Schedule System
TRW is utilizing a top level computerized cost/schedule

system which will allow top management to know pictorially when selected cost and scheduled thresholds and gates are exceeded at any level of a program.

o Productivity Incentive Clause

NASA and TRW have adopted a Productivity Effectivity Modification (PEM) clause in the contract which will allow TRW to receive 20 percent of money saved, some of which will be distributed to TRW employees, based on money-saving productivity ideas. TRW is substantiating its performance by agreeing that cost savings will revert back to NASA if the project does not meet its operational goals.

V Trying Out New Management Practices and Using New Technology

NASA places strong emphasis on Program goals and objectives. Their articulation communicates the aims of management and encourages goal setting throughout the organization. In addition to publishing NASA's Goals and Objectives, we have also published NASA's Management Principles. These Principles are designed to permeate all aspects of NASA's missions with a philosophy of NASA's management style.

NASA'S PRODUCTIVITY PRINCIPLES TO ACHIEVE EXCELLENCE

We Demonstrate Belief In Our People By:

Taking on inspiring National goals, translating them to challenging objectives at each level, and acknowledging the collective responsibility of managers and team members.

Demonstrating confidence and respect for all members of the NASA Team, rather than depending upon regulating behavior through excessive rules and regulations.

Entrusting responsibility and authority to the lowest practicable operating level in order to encourage initiative and pride and to minimize bureaucracy and paperwork.

Encouraging honest, open, and frequent two-way communication on all matters affecting team members and the work.

We Manage for Success By:

Hiring a high quality and integrated work force, providing them opportunity for creative and productive work, and maintaining a positive climate for personal development and career growth.

Stressing world-class quality and pride in performance at every working level and recognizing and rewarding each outstanding contribution.

Communicating clearly defined goals and focusing on successful performance through systematic program planning and execution.

Encouraging as much contractor competition as appropriate, and executing through non-adversarial team efforts.

Providing to all offices and facilities the modern equipment needed for quality and productive work.

We Operate With an Open Management Style By:

Recognizing that inherent in R&D are high-risk and high-payoff efforts, and maintaining high technical credibility and improving performance through free and open reviews of technical failures.

Encouraging those who are responsible for carrying out the work to make suggestions for improvements and to participate in the planning.

Providing ample opportunity for our people to communicate with the best minds in science and technology in other organizations.

Maintaining integrity in all our dealings with the NASA Team and all outside individuals and organizations.

VI Evolving Productivity Trend Analysis (Measurement Systems)

A common element in all comprehensive productivity initiatives is some form of analysis: a system that lets you know how well you are doing and in what areas you should improve. At NASA, such a system is called Productivity Trend Analysis (better known as Productivity Measurement). The objective of Productivity Trend Analysis is to initiate and implement an Agency-wide system for measuring productivity improvement and quality enhancement at each of the NASA installations and with its contractors.

Productivity Trend Analysis

An important difference must be drawn between traditional methods for measuring productivity (time and motion studies and work sampling) in white collar organizations and trend

analysis. Trend analysis is a participative management approach whereby managers and employees agree on the indicators of productivity and quality for their organization. Sample indicators are milestones completed, timeliness of response to inquiries, number of claims processed--work that reflects an organization's mission. These can be quantitative or qualitative indicators. The Nominal Group Technique is recommended as the most appropriate method for arriving at these indicators. Managers must develop useful analyses to manage their groups effectively, and employee involvement and consensus on selected indicators of productivity and quality very often reinforce commitment to performance.

The resulting analyses will be useful to support requests for developing new programs, and documented successes will be available for use in congressional testimony and Office of Management and Budget budget hearings. Furthermore, the analyses will be useful for responding to Reform '88 initiatives, as well as the legal requirement of reporting productivity data annually to the Bureau of Labor Statistics.

The Agency has an excellent opportunity now for developing its own measurement system which will reflect the productivity of the entire organization, including the all-important R&D activities. For this reason, it is anticipated that 10 to 20 percent of the workforce at all installations will participate in a pilot program to arrive at such analyses.

American Productivity Center White Collar Study

NASA is one of thirteen organizations participating in a two-year pilot Productivity Improvement Project to advance state-of-the-art understanding of productivity improvement issues in the white collar workforce. The study comes under the direction of the American Productivity Center in Houston, Texas, and was initiated in September 1983. Three aerospace companies are participating (McDonnell Douglas, Rockwell International Corporation, and TRW, Inc.). The study includes specific organizational functions, such as research and development, engineering, information services, accounting, marketing, and personnel. NASA has initiated projects at Johnson Space Center, Goddard Space Flight Center, Marshall Space Flight Center, Kennedy Space Center, Lewis Research Center, and the National Space Technology Laboratories. Periodic group meetings are scheduled for the purpose of increasing the dialog among participants and assessing progress. A public conference will be held at the conclusion of the two-year project (during 1986) to share results with a larger audience. Sponsors, network members, and the American Productivity Center will jointly plan and participate in the conference.

VII Noting, Rewarding, and Diffusing Successful Approaches Throughout the Organization

Productivity improvements in organizations occur if everyone understands the goals and objectives of management. NASA is disseminating information to encourage "employee ownership" of productivity improvement and quality enhancement goals and objectives.

NASA Productivity and Quality 1983 Summary Report

The 1983 Summary Report describes in greater detail and variety specific management and technology innovations being implemented throughout NASA. The first printing was 500 copies, and it is now in its second printing. The report will be updated on an annual basis; the 1984 edition will be available in January 1985. Again, it will be based on comprehensive reports submitted by each installation and will continue to emphasize those managerial and technical practices that are directly linked to the Agency's productivity goals.

Awards Equity

Successful companies emphasize the importance of providing employees with recognition and rewards for a job well done. To be truly effective, however, recognition and rewards should be equitable, timely, and specific. While there is less consensus on the best approach to achieve equity in recognition and rewards, successful managers agree that those employees who have been directly involved in accomplishing an objective should be recognized. Not only is this fair, but it also fosters employee commitment to the goals of the organization. NASA endorses this concept and is encouraging a greater distribution of monetary and non-monetary awards among all NASA employees.

NASA Excellence Award for Quality and Productivity

The NASA Excellence Award for Quality and Productivity is being developed to recognize outstanding commitments to quality and productivity by contractors, subcontractors, and suppliers. The award, modeled after the prestigious Deming Prize in Japan, will be jointly sponsored and administered by NASA and an outside professional group. It is anticipated that the first nominations will be made in 1985 and the first award made in 1986.

The basic concept for the Award is self-nomination by companies which have demonstrated a continuous commitment to quality enhancement. Criteria, established by a government/industry group, include (1) a total commitment to high quality and productivity, (2) customer satisfaction, and (3) verifiable achievements in quality and productivity.

On-site visits to companies will be part of the review and evaluation procedures.

National Symposium on Productivity and Quality: Strategies for Improving Operations in Government and Industry

NASA is sponsoring a National Symposium on Productivity and Quality at the Capital Hilton Hotel, Washington, DC, on September 25-26, 1984.

The goal of the symposium is to discuss strategies for improving operations in government and industry. A total of six hundred top executives from one hundred companies, thirty-five government agencies, and twenty universities will participate. President Reagan has been invited to deliver the keynote address.

The symposium will provide a forum for discussion of white collar productivity issues by experienced executives from successful organizations. It will focus on white collar organizational issues that are common to large companies and technology-oriented organizations. It will also produce action items that will be useful for the various Presidential Cabinet Councils and Congressional Committees. The symposium will be operated by the American Institute of Aeronautics and Astronautics.

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